



## Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

## PUBLIC HEALTH AND EXPERIMENTAL BIOLOGY

By Professor HARRY BEAL TORREY

UNIVERSITY OF OREGON

### I

**L**AST October, in the library of the College of Physicians in Philadelphia, I came upon a letter from Lord Lister to Dr. W. W. Keen. It was dated 4th April, 1898. It began as follows:

12 Park Crescent, Portland Place, London W.  
4th April, 1898.

My Dear Sir:

I am grieved to learn that there should be even a remote chance of the legislature of any state in the Union passing a bill for regulating experiments on animals.

It is only comparatively recently in the world's history that the gross darkness of empiricism has given place to more and more scientific practice; and this result has been mainly due to experiment upon living animals. It was to these that Harvey was in a large measure indebted for the fundamental discovery of the circulation of the blood. And the great American triumph of general anæsthesia was greatly promoted by them. Advancing knowledge has shown more and more that the bodies of the lower animals are essentially similar to our own in their intimate structure and function; so that lessons learned from them may be applied to human pathology and treatment. If we refuse to avail ourselves of this means of acquiring increased acquaintance with the working of that marvelously complex machine, the animal body, we must either be content to remain at an absolute standstill or return to the fearful haphazard ways of testing new remedies upon human patients in the first instance, which prevailed in the dark ages. . . .

My own first investigations of any importance were a study of the process of inflammation in the transparent web of the frog's foot. The experiments were very numerous and were performed at all hours of the day in my own house. I was then a young unknown practitioner; and if the present (English) law had been in existence, it might have been difficult for me to obtain the requisite licenses; and even if I had got them, it would have been impossible for me to have gone to a public laboratory to work. Yet without these early researches which the existing law would have prevented, I could not have found my way among the perplexing difficulties which beset me in developing the antiseptic system of treatment in surgery.

In the course of my antiseptic work at a later period I frequently had recourse to experiments on animals. One of these occurs to me which yielded particularly valuable results, but which I certainly should not have done if the present law had been in force. It had reference to the behavior of a thread composed of animal tissue applied antiseptically for tying an arterial

trunk. I had prepared a ligature of such material at a house where I was spending a few days at a distance from home; and it occurred to me to test it upon the carotid artery of a calf. Acting on the spur of the moment, I procured the needful animal at a neighboring market; a lay friend gave chloroform and another assisted at the operation. Four weeks later the calf was killed and its neck was sent to me. On my dissecting it, the thread, instead of being thrown off by suppuration, had been replaced under the new septic conditions, by a firm ring of living fibrous tissue, the old dangers of such an operation being completely obviated. . . .

At the very time that I was reading these words, twenty-two years after they had been written, *The Country Gentleman* for October 16, 1920, was carrying broadcast over the United States an article entitled "Vivisection" by an antivivisectionist, which after exhibiting the grossest ignorance of the purposes and practices of contemporary investigators who use animals in their experiments concludes as follows:

Alienists—Doctor Bishop and various others of high standing—have taken a further step than the mere plea of needless cruelty in their arraignment of vivisection.

They claim that vivisectors are not actuated by any scientific zeal, but are mental degenerates. In other words, that vivisection is a recognized form of mental perversion—a savage mania which is known to the keepers in every mad house. It is of the same order as the spirit which incites murderers of a certain type to rip their human victims' bodies to pieces. ! !

The author is obviously irresponsible, and his work would be negligible were it not for the fact that it receives official endorsement. On the editorial page, under the caption "Vivisection," cognizance is taken of the statement already quoted, in an editorial which is essentially a brief abstract of the article ending with these words:

Other doctors, here and in Europe, go a step further, by declaring that cases of a recognized form of mental perversion are known among vivisectors. The public should understand this vivisection argument from both sides. The accompanying article supplies such needful information in a way to prove antivivisection's case.

My attention had been attracted originally to this number of *The Country Gentleman* by editorials in two eastern newspapers that were disposed to be sharply critical of the appearance of this propaganda on the eve of the November election in California where an antivivisection measure was on the ballot.

The motive prompting the appearance of the article at that time need not concern us. The charges implied in the editorials to which I refer have been officially denied, and I am glad to accept the denial. Indeed, it should be said that on February 12 *The Country Gentleman* printed a very able defense by Dr. W. W.

Keen of what he very properly calls experimental research. It even introduced with kind words the widely known and respected author. Its editorial columns are, however, silent. This silence after Dr. Keen's admirable exposition of the facts contrasts significantly with the warm editorial endorsement of the October article, in which one looks in vain for the slightest first hand knowledge of contemporary experimentation.

Yet *The Country Gentleman* is published in Philadelphia. The Saturday Evening Post, published by the same company, was founded by Benjamin Franklin, the same Benjamin Franklin who was one of the founders of the Philadelphia Hospital in which the students of the first school of medicine to be founded in the United States were taught by its first professor of clinical medicine. From that time Philadelphia has been a great seat of medical learning. Two of our best medical schools now flourish there. On the roster of the College of Physicians are many of the most illustrious names in the medical history of the last century and a half. Its wonderful library is said to be surpassed in this country only by that of the Surgeon General's Office in Washington.

## II

There is no need to dwell further on this remarkable exhibition of opposition to a principle which has not only been repeatedly established in fact, but has recently been ratified by a decisive majority at the polls. California is free, for the present at least, to safeguard the health of its people by the necessary research.

What part may experimental biology be expected to play in this connection?

An answer to this question will depend first upon what we may consider experimental biology to be. As I think of it, its limits are set by no group of organisms nor by any circumscribed body of facts. The field of experimental biology is the living world. Its materials are omnipresent there. Its problems are general, fundamental problems of organisms, carried to the limits of human interest. Its method is analytical. Its object is the discovery of mechanisms, processes, dynamic relations. I like to think of it as an attitude of mind rather than a department of biological knowledge. For there is no department of biological knowledge that may not reveal this interest in the fundamental problems, dynamic relations, and analytic methods which to my mind characterize experimental biology.

What is the relation between experimental biology, thus conceived, and the public health?

Health is a name we apply to a standard of mental and physical

fitness that varies with our enlightenment and our individual necessities. This standard is maintained by both private and public agencies. Private agencies are concerned primarily with individual cases involving some form of treatment. This treatment may be: (1) applied by the individual himself when in control of the necessary means, as provided, for instance, by the rules of personal hygiene or athletic training; or (2) applied by an expert upon whose superior skill or insight he temporarily relies.

These experts form a heterogeneous assemblage, including such different elements as masseurs and physio-therapists, physical directors, physicians and surgeons and all others who may be licensed by law to render professional services under definitely prescribed conditions. This heterogeneity raises many perplexing practical problems, which however, need not detain us here.

While private agencies are concerned primarily with the problems of private individuals, public agencies are concerned primarily with the interests of the public as a whole, especially with those sources of danger whose control demands collective as against individual effort. The general method of the public agencies is *prevention*. This we are accustomed to contrast with *treatment*, the traditional method of the private agencies. These methods in certain respects, do contrast sharply with each other. Where prevention succeeds, treatment becomes superfluous. And in so far as private practice is dependent upon the treatment of preventable disorders, its function is temporary only—of the nature, let us say, of emergency service. But it must be recognized that treatment may be essentially preventive in nature, and is becoming more and more so, as old-fashioned prescription writing is displaced by the instruction of patients in the care of their bodies and the avoidance of disease. The functions of private and public agencies are thus entirely compatible. No reputable physician will prolong treatment for his own profit, nor will he hesitate to make it unnecessary if he can. Though worthy of his hire, he is nevertheless a public servant. Under no other theory can the state appropriate the sums it does for his professional training. It is his duty to destroy disease and develop a sturdy race just as it is the duty of the teacher to dispel ignorance and encourage resourceful, self-reliant minds. His is a double function: to cooperate with public agencies in preventive measures and to care especially for those whom such measures have failed to protect.

So much for the relation of public and private agencies. From whatever angle the problems of health may be contemplated, they are scientific problems. They are also fundamentally biological problems, of a sort to invite an experimental method of attack.

## III

The problems of public health center about the control of the causes of disease. Disease may be defined as a more or less radical departure from a standard of bodily or mental health, variously determined, which may be taken as a standard of reference. It is a relative term, in no sense a definite entity. Thus defined, it has a variety of causes. Some of these are well known, and form the basis of the public health work of the present day. Some of them—how many we cannot say—are quite unknown. It is toward the discovery and control of these that experimental biology may be expected to make its chief contributions to the health of the future. Accordingly I shall attempt to gain space for the discussion of these problems of the future by avoiding more than a summary reference to the conquests of the past.

These conquests were largely initiated by Pasteur and a few of his contemporaries. The mysteries of suppuration vanished in the light shed by his experimental studies on fermentation. And contagion received its clear explanation in the demonstration of the transportation of an infecting organism by some appropriate carrier from one host to another. Thence arose a dominant motive in prevention, the discovery and eradication of pathogenic organisms and their means of dispersal—by fumigation, quarantine, sanitation, destruction of breeding places, and carriers and their breeding places, and so on. New organisms are being almost daily discovered—witness the organism of yellow fever recently isolated by Noguchi, and many additions to our knowledge of the intestinal fauna to which Professor Kofoid and his co-workers have made such notable contributions.

When it is not possible to prevent infection, the same result, since Pasteur, may be achieved by immunizing the host with specific antitoxic sera and vaccines of various sorts.

When neither contagion can be prevented nor immunization effected, it is naturally sound practice to discover the infection at the earliest possible moment. This is one reason for such agencies as public health nurses and public dispensaries.

Education in hygiene is another means of prevention—efficacious both against infectious diseases (*e. g.*, tuberculosis) and those lapses from health that are referable to other causes connected with the customary mode of life, such as bad housing, dangers of occupation, unsatisfactory food and clothing, and so on.

With this sketchy summary of public health activities as they are commonly practiced, we may turn to certain aspects of the general problem which have for the most part a future signifi-

cance. First, let us consider the group of psychopathic disorders. These are due to a variety of causes, among which are defective inheritance, syphilis, alcoholism, accidental injuries, social including occupational maladjustments, sex maladjustments, defects in education, especially early education. The first may be controlled by prevention of propagation, and in severe cases in no other way, as has been established by studies in heredity. The manner of prevention is open to question. Segregation of the sexes is entirely possible, but presents some practical difficulties at the present time. Sterilization laws are in effect in a few states. But the recent experimental results of Steinach throw some doubt upon the all-round efficacy of the usual method of vasectomy. In the tests of rats whose *vasa* had been ligated, the sex cells degenerated; but the interstitial tissue hypertrophied with a corresponding augmentation of the sex impulse. It is obvious that such an operation, effective though it may be as a method of sterilization, is of questionable protection for the public against a potential rapist and carrier of venereal disease. Further experiments are needed.

Syphilis continues to resist all methods of prevention, but infections are subject to control as a result of the experimental investigation of Schaudinn, Metchnikoff, Ehrlich and others; that complete cures are effected, however, has still to be demonstrated.

Alcoholism is—theoretically—preventable by law. There can be no question of the salutary effect of even our present degree of prohibition upon the prevalence of venereal disease and the milder psychopathic cases, as well as crime and poverty. As a cause of degeneracy Pearson's well-known statistics are supported, on the one hand, by the performances of Pearl's alcoholized fowls, and opposed, on the other, by Stockard's degenerate guinea pigs which continued to reappear for several generations after one ancestor, a male, had become an involuntary victim of alcoholism. Whether the present law in the United States represents a position of biological stability can not be determined until further careful experimentation produces more, and more varied, data on the physiological effects of alcohol on the human mechanism as a whole.

Social and occupational maladjustments, though often apparent to casual inspection, offer to the nerve physiologist and psychologist a multitude of subtle problems in abnormal human reaction that have hardly begun to receive proper attention, important though they appear in the analysis of psychopathic cases.

Sex maladjustments, further potent sources of ill health, present another array of problems to the student of nerve physiology and the endocrine organs and their inter-relations, that have so far been merely reconnoitered.

Finally, the education of early life provides large opportunity for the crossing of reflexes in tangled patterns that exert a warping influence upon normal behavior. Here is a field for both biological experimentation and the prophylaxis of biological instruction. We hold our young too cheap. To develop with careful teaching their natural interest in themselves and the normal processes of organic nature, is to provide insurance toward a normal life.

In a second group of disorders that from the increasing frequency of their incidence and their obscure causation are of distinct public concern, I have placed the malignant tumors and the affection of the endocrine glands.

Time will not permit me to dwell upon the grave seriousness of the problems they present, and the great opportunities they afford for experimental analysis.

Similarly it will not be possible to consider further the subject of eugenics, which has already been touched upon in connection with psychopathic disorders.

The few illustrations that have been cited will suggest something of the place of experimental biology in the medical research of the future.

#### IV

In closing I would like to tell you of two education experiments that are being made in Oregon bearing on the present subject of discussion. The first is the introduction of elementary biology into the school systems of three cities of the state. The courses are planned for the third to eighth years (inclusive) of school life. They are in charge of specially trained teachers who are undertaking to teach the subject as science and encourage the experimental method. The results for the past year are everything that could be wished. The children are enthusiastic, and have carried the infection of their interest to other classrooms and to their homes. The wide-ranging observation, initiative, inventiveness, keen criticism and clear thinking of these eight-to-ten year olds have astonished and pleased parents and school authorities alike.

The course covers the whole field of biology. One of its objects is to provide a natural, unconscious and authentic approach to the problems of adolescence. To one who has waited many years for the establishment of such instruction, the admirable teachers' reports embodying its first fruits read like fairy tales. I suggest it as a serious experiment in mental and moral prophylaxis.

The second project to which I have invited your attention is a seven year course in medicine. The student who enters the univer-



sity with the intention of studying medicine enrolls at once as a student of medicine, in a curriculum that extends without break through the seven years of formal instruction preceding the assumption of his professional degree.

The prime object of this curriculum is the fusion of those phases of medical education that are customarily known as the work of the pre-medical, pre-clinical and clinical years into a single organic whole. By this means it is hoped

(1.) To introduce students early to medical problems that they may see the very practical connection between their basic work and ultimate professional success—avoiding, however, the serious error of permitting the substitution of the superficial drama of the clinic for the fundamental scientific knowledge on which their later clinical success must rest.

(2.) To stimulate intensive cultivation of the medical sciences, biology, chemistry, physics and psychology, by means of which to continue indefinitely to live in the present of medical achievement—to quicken especially the spirit of research.

(3.) To indicate that medicine is beyond all things a calling that makes demands on every human resource—on all the fullness of experience, the ripeness of wisdom, the subtle understanding of men.

4.) To make every student of medicine wise and skilful in the technic of his profession.

(5.) To make him a public-minded citizen, thoughtful of his community, jealous for its future.

It may be said further that a department of experimental biology has been added to the traditional subjects provided by law for medical schools, and a directorship of research in fundamental medical science with functions extending throughout the entire seven year course.

These are concrete expressions of the view that has been here supported—that medicine has a biological foundation and with the public health must needs prosper on biological research.